PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : **B65D 79/00**

A2

(11) International Publication Number: **WO 95/04688**

(43) International Publication Date: 16 February 1995 (16.02.95)

(21) International Application Number: PCT/GB94/01659

(22) International Filing Date: 1 August 1994 (01.08.94)

(30) Priority Data:
9316197.4 5 August 1993 (05.08.93) GB

(81) Designated States: AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, ES, FI, GB, GE, HU, JP, KG, KP, KR, KZ, LK, LU, LV, MD, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
Without international search report and to be republished upon receipt of that report.

(71) Applicant *(for all designated States except US)*: PA CONSULTING SERVICES LIMITED [GB/GB]; 123 Buckingham Palace Road, London SW1W 9SR (GB).

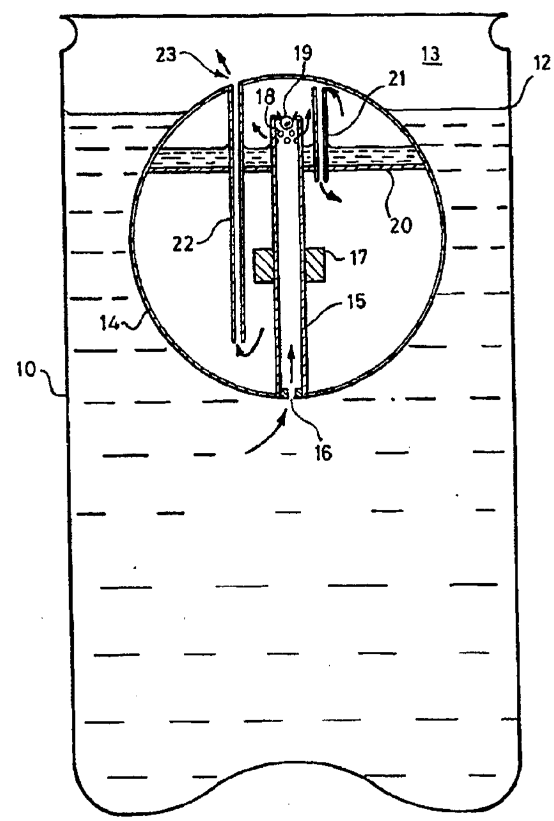
(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: HOUZEGO, Peter, John [GB/GB]; 8 The Drift, Oakington, Cambridge CB4 5AD (GB). WOOD, Timothy, Michael [GB/GB]; 6 The Lawns, Melbourn, Royston, Hertfordshire SG8 6BA (GB). COX, Peter, Erich [GB/GB]; 1 March Lane, Cherry Hinton, Cambridge CB1 3LG (GB).

(74) Agent: NASH, Keith, Wilfrid; Keith W. Nash & Co., Pearl Assurance House, 90-92 Regent Street, Cambridge CB2 1DP (GB).

(54) Title: DEVICE FOR PRODUCING A HEAD ON A BEVERAGE

(57) Abstract

A device for generating a head on a sealed container beverage when the container is opened, comprising a capsule (14) which initially floats on the beverage and has a first aperture (16) below the liquid surface through which can enter a capsule compartment from which gas is displaceable into the container headspace via a second aperture (23) and a ballast means with which the entering liquid combines to cause the capsule to invert, preferably after sinking, whereby a movable valve closure element (19) traps a volume of gas in the capsule which, when the container is opened, can escape through the depressurised liquid to cause formation of a head on the beverage.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	**GB**	United Kingdom	**MR**	Mauritania
AU	Australia	**GE**	Georgia	**MW**	Malawi
BB	Barbados	**GN**	Guinea	**NE**	Niger
BE	Belgium	**GR**	Greece	**NL**	Netherlands
BF	Burkina Faso	**HU**	Hungary	**NO**	Norway
BG	Bulgaria	**IE**	Ireland	**NZ**	New Zealand
BJ	Benin	**IT**	Italy	**PL**	Poland
BR	Brazil	**JP**	Japan	**PT**	Portugal
BY	Belarus	**KE**	Kenya	**RO**	Romania
CA	Canada	**KG**	Kyrgystan	**RU**	Russian Federation
CF	Central African Republic	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CG	Congo			**SE**	Sweden
CH	Switzerland	**KR**	Republic of Korea	**SI**	Slovenia
CI	Côte d'Ivoire	**KZ**	Kazakhstan	**SK**	Slovakia
CM	Cameroon	**LI**	Liechtenstein	**SN**	Senegal
CN	China	**LK**	Sri Lanka	**TD**	Chad
CS	Czechoslovakia	**LU**	Luxembourg	**TG**	Togo
CZ	Czech Republic	**LV**	Latvia	**TJ**	Tajikistan
DE	Germany	**MC**	Monaco	**TT**	Trinidad and Tobago
DK	Denmark	**MD**	Republic of Moldova	**UA**	Ukraine
ES	Spain	**MG**	Madagascar	**US**	United States of America
FI	Finland	**ML**	Mali	**UZ**	Uzbekistan
FR	France	**MN**	Mongolia	**VN**	Viet Nam
GA	Gabon				

DEVICE FOR PRODUCING A HEAD ON A BEVERAGE

Field of invention

This invention concerns devices for assisting in the production of a so-called head when packaged beverage, especially alcoholic beverage and particularly beer, stout, ale, lager and lager-beer, is poured from the package. Such devices will be referred to herein as head generating devices.

Background to the invention

Head generating devices for use with sealed containers such as cans generally comprise small capsules of gas retained at or above internal container pressure. The capsule is usually retained near the base of the container. The action of opening the latter causes the in-container pressure to drop to atmospheric thus allowing gas to escape from the capsule into the beverage so creating a head on the beverage.

Conventional devices although effective are difficult to insert into container and are generally sensitive to the tolerances of the plastics moulding and container manufacture. The result is that filling line capacity is often significantly reduced and container costs can be higher due to the tighter tolerance range necessary. Furthermore such devices must be held tightly in the container so as to remain in position despite their inherent buoyancy to allow charging with gas when the container is inverted and discharging gas from the bottom of the container on opening. This imposes restrictions upon capsule design, container type and tolerance, filling line speed of operation, washing, prefilling and assembly automation.

Clearly if such devices can be designed which do not have to be

constrained to remain in a particular position within a can or other container, many of the above problems will be eliminated.

Object of the invention

It is one object of the present invention to provide a head generating device for entrapping a volume of gas under pressure in a sealed container partly filled with beverage under pressure, which is more suited to mechanical handling thereby simplifying insertion into the container.

It is another object of the invention to provide such a device which can be charged with gas under pressure from the headspace gas in the container without the need to invert the container to bring the capsule into the headspace.

It is a further object of the invention to provide such a device which does not need to be secured in position in a container.

It is a still further object of the invention to provide such a device which does not need to be inserted into a container in any particular orientation.

Summary of the invention

According to one aspect of the present invention a head generating device comprises a substantially hollow capsule having a first aperture, a second aperture remote from the first aperture, ballast means within the device selected as regards mass and position therein such that the capsule will float in a liquid with the first aperture above the liquid surface and the other immersed, and wherein liquid can enter an uppermost compartment in the capsule through the immersed aperture, the mass of liquid entering the capsule combining with the ballast to cause the capsule to rotate at least to the extent that the respective conditions of the two apertures are reversed, and a

movable valve element within the capsule which can be closed so that when the latter is rotated the further ingress of liquid is inhibited and a volume of gas is trapped therein.

If such a device is located within a sealed and pressurised container which is partially filled with liquid, the interior of the capsule will be pressurised by the gas in the headspace above the liquid to the same elevated pressure as that of the headspace. After it rotates, the trapped gas remains at the elevated pressure and is available to exit from the capsule when the container is opened and the pressure in the container drops.

Where the liquid contains dissolved gas such as nitrogen and carbon dioxide and the issuing gas has to pass through the liquid before it can escape to atmosphere, the issuing gas can be arranged to initiate an avalanche effect on the dissolved gases and create a head of fine bubbles on the liquid.

Generally it is necessary for the issuing gas to be in the form of a fine jet to achieve significant head production to which end the size of the aperture through which the gas is to issue into the liquid is selected so as to create such a desired jet.

The valve element may be operated for example by inversion of the capsule or by a timing device or by a temperature sensitive device or by a magnetic field or by relative movement between a flotation member and the capsule wall, or by the entry of liquid into the capsule and the movement of a diaphragm or expansible member thereby within the capsule, or any combination thereof.

The ballast means may be fixed in position within the capsule or may be upwardly movable therein as a consequence of the ingress of liquid to which end the ballast means may be a buoyant member which rises with the rising level of liquid within the capsule so as to raise the centre of gravity of the capsule and create an unstable condition and cause the capsule to at least partially invert into a position of stability.

6/22/2009, EAST Version: 2.3.0.3

According to a preferred feature of the invention the second aperture communicates with the interior of the capsule by means of an elongate open ended tube which extends across the capsule to a position therein which is close to but spaced from a first internal region (compartment) of the inside surface of the capsule which is diametrically opposite the position of the said second aperture, the said first aperture is situated in a region of the capsule wall which is close to but not aligned with the open end of the first said elongate tube, and the said first aperture communicates with the opposite region of the capsule interior by means of a second elongated open ended tube.

The said second tube extends from the said first aperture internally of the capsule generally parallel to the first mentioned tube the length of the tube or pipe associated with the said first aperture being selected so that when the capsule is inverted and the said first aperture is on the underside of the capsule, the other (now upper) end of the second pipe is situated in a region of the capsule which contains gas and is above the level of any liquid contained in the capsule as a result of ingress of liquid during the priming step when liquid can enter the capsule.

Typically the size of the first aperture is in the range 150-300 microns diameter.

According to a preferred feature of the invention the said internal region of the capsule is separated from the rest of the interior by means of an impermeable membrane or platform and the first and second tubes extend through and are externally sealed thereto where they pass therethrough.

Preferably the platform/membrane is situated nearer to the open end of the first tube than the other end thereof so that the volume of the said first internal volume (compartment) is less than the remaining volume of the interior of the capsule

6/22/2009, EAST Version: 2.3.0.3

(hereinafter described as the second internal volume of the capsule).

Preferably fluid communication is permitted between the first and second internal volumes of the capsule so that as liquid enters the first said valve gas is displaced via the said first communication to the said second internal valve, and gas can pass to the headspace via the second tube and the first aperture to maintain pressure balance as between inside and outside the capsule.

The platform may be formed with an upstanding perimeter wall defining a tray for collecting liquid and retaining same at the upper end of the capsule during the initial orientation thereof in a liquid.

Alternately and preferably the fluid communication is by means of a third tube which sealingly extends through the platform.

Where a third tube is employed, it preferably extends above the platform into the said first internal volume to a position just below the internal wall of the capsule. The third tube need not extend below the platform into the second internal volume of the capsule but if so it only needs to extend thereinto by a small distance.

Typically the ballast comprises an annular weight fitted around the first mentioned pipe or tube which extends from the said second aperture into the capsule and is positioned therealong just below the centre of area and having a mass which is such that the capsule will settle with the small first aperture positioned just above the surface of the liquid.

When initially deposited into liquid such as beer in a container which is partially filled with beer and is thereafter sealed so that the headspace above the beer can be pressurised, the capsule will initially float allowing pressure equalisation to occur as

Nitrogen and Carbon Dioxide pressure is built up within the container as will occur after sealing and more so during a pasturisation process when the temperature of the can is raised. The capsule will remain buoyant for a period of time determined by the rate at which liquid enters the upper chamber (first internal volume) of the capsule via the first tube. This entry will continue until the buoyancy of the device is sufficient to keep the capsule afloat and it sinks. If the device is to sink, it is important that the buoyancy changes so far do not alter the stability of the capsule and cause it to "turn over", since this would prevent further liquid entry.

Provided the capsule orientation remains constant, readily achieved by appropriate positioning of the ballast, liquid will continue to enter until the centre of mass moves above the centre of area due to the liquid being retained in the upper region of the capsule above the platform. As the centre of mass shift occurs, the device will rapidly flip so that the small hole originally at the top of the capsule is now positioned at the bottom. Thereafter the device will remain in this orientation, whatever the orientation of the container, provided there is no significant further ingress of liquid and the pressure of the internal volume of gas trapped in the capsule will be maintained.

Liquid entry in this orientation can be prevented by the movable valve closure element automatically when the capsule flips.

Preferably a buoyant element is located within the said first tube to close the element means in response to rotation of the capsule, as the buoyant element in the first tube transfers therein from one end to the other.

Upon opening the container, depressurisation occurs thus causing gas inside the capsule to vent rapidly into the liquid through the small lower hole. Where the liquid is a beer or other beverage containing dissolved gases, the venting liquid will cause gas to come out of solution and create a mass of bubbles

to rise to the surface and create a head. The closure of the valve associated with the first tube will prevent any liquid or gas from exiting through the first tube and the second hole at the upper end thereof.

A particular advantage of a device such as described is that by appropriate selection of position and/or direction of jet, the exiting gas from the capsule can cause the latter to rotate within the container thus expelling of gas around the whole of the cross-sectional area of the liquid in the container improving the overall head production performance.

The device does not have to sink to the bottom to function but can be made to work as a non-sinking device remaining on the surface at all times but inverting after sufficient liquid has entered the capsule. The otherwise is otherwise similar to the sinking device previously described.

According to another aspect of the invention a one way valve may be located in one or both of the apertures in the capsule and the capsule is weighted to float in a particular orientation with the upper aperture allowing flow of gas from the headspace into the device and the lower aperture permitting positive pressure inside the device to vent through the submerged hole.

A preferred shape of capsule is spherical, but cylindrical, rectilinear, trapezoidal, hemispherical and other shapes may be utilised. Clearly the shape of the capsule and the relative positions of the apertures and internal tubes and ballast etc, may affect its stability when floating and enable a more bistable type of operation to be achieved as between one orientation and the other, as compared with the more gentle rotation which may be associated with a spherical device.

According to another aspect of the present invention there is provided a container partially filled with a liquid having gas dissolved therein and a headspace above the liquid containing gas

at a pressure greater than atmospheric, and located within the said container a head generating device containing gas under pressure as aforesaid, so that when the end of the container adjacent the headspace is broached as by severing a weakened tab region and the headspace pressure is relieved to atmosphere the trapped gas under pressure within the capsule will be jetted into the liquid to assist in the generation of an upward avalanche of small bubbles to form a head on the surface of the liquid when the latter is poured into a glass or other drinking vessel.

According to another aspect of the present invention a method of trapping a volume of gas under pressure within a capsule located within a sealed container having liquid therein containing dissolved gases and a headspace containing gas under greater than atmospheric pressure comprises the steps of, causing liquid to enter the capsule and thereby alter the stability thereof and result in a rotation of the capsule so that an aperture through which liquid is entering the capsule rises above the surface of the liquid and a smaller aperture through which gas is to jet when the can is opened is caused to rotate below the level of the liquid within the container.

According to another aspect of the invention in a method as aforesaid, the volume of liquid entering the capsule is arranged to alter the buoyancy thereof to such an extent that the capsule sinks within the liquid either before, after or during inversion so that the device is situated at or near the bottom of the container at the time when the can is broached and the headspace pressure relieved.

A key advantage of regularly shaped, smooth surfaced devices is the ease with which such devices can be separated from the bulk and handled at high speed. This is particularly the case where spherical shapes are involved. This makes such devices particularly suitable for insertion into containers at high speed immediately after filling.

6/22/2009, EAST Version: 2.3.0.3

Bulk spherical devices behave in a similar way to non-viscous fluids making the process particularly attractive for canning applications since the handling technology becomes broadly similar to that of handling liquids.

In a canning plant, capsules waiting to be inserted into cans are preferably maintained in an inert atmosphere typically Nitrogen, preferably under pressure greater than atmospheric, so that the capsules are oxygen free when delivered to the cans, so that there is a minimum of oxygen present in the can after sealing to cause unwanted oxidation of beverage in the can.

The invention will now be described by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a cross-sectional view through a can containing a capsule constructed in accordance with the invention;

Figure 2 is a similar view in which the capsule has inverted and sunk;

Figures 3A and 3B show detail of the elastomeric one way valves;

Figure 4 shows the modified capsule inverted and sunk;

Figure 5 is a diagrammatic plan view illustrating how a can filling carousel can be followed by a capsule inserting carousel;

Figure 6 illustrates how spherical capsules can be handled prior to insertion into cans;

Figure 7 shows how spherical capsules can be aligned and fed to cans on a filling line; and

Figure 8 is a perspective diagrammatic view of a can filling line incorporating the arrangements of Figures 6 and 7.

Detailed description of drawings

In Figure 1 a can 10 sealed with a lid 11 containing nitrogenated beer 12 below a headspace 13 containing Nitrogen gas under pressure and possibly Carbon Dioxide gas as well contains a floating spherical shell 14. The latter includes an inner tube 15 extending upwardly from a small opening 16 and a weight 17 is fitted to the tube 15 slightly below the centre of area. The mass of the weight 17 is selected so that the shell 14 when empty (other than containing air) will float substantially submerged as shown in Figure 1.

The upper end of the tube 15 is apertured as at 18 and is closed at its upper end to trap a small ball 19 in the tube. The ball 19 is hollow and floats on beer and thus rises in the tube with the ingressing beer. The lower end of the tube 15 is formed with a reduced diameter entrance as by an annular ring or other inward protrusion so that the ball 19 cannot leave the tube after it has been fitted therein during manufacture but beer can still enter the tube through the restricted aperture 16.

Beer entering the capsule 14 spills over onto a platform 20 which extends completely across the interior of the capsule and closes off the upper end from the remainder thereof. A tube 21 extends through the platform wall 20 so as to permit gas trapped in the space above the platform to displace into the compartment below the platform as beer enters the upper compartment from the holes 18 in the tube 15. A third tube 22 also extends through the solid platform 20 so as to communicate between the lower region in the capsule below the platform and a second aperture in the wall of the capsule at 23. This second aperture is much smaller than the first and is typically in the range 150-300 microns diameter.

Where the tubes 22 and 21 pass through the platform, they are sealed thereto so that the only communication between the upper and lower chambers within the capsule is via the tube 21.

Gas or air displaced from the upper compartment into the lower compartment via tube 21 displaces gas or air up tube 22 and out through the aperture 23.

As liquid continues to enter the capsule and fill the upper compartment, the buoyancy of the capsule is reduced causing it to sink lower into the beer and by selecting the weight of the mass 17 appropriately, when the upper compartment is say one half full, the overall buoyancy of the capsule is reduced such that it will no longer float and the capsule simply sinks slowly to the bottom of the can.

Again by selecting the position of the mass 17 relative to the centre of area, and the relative weights of it and the liquid above the platform 20, the central mass of the capsule can still be arranged to be below the centre of area when the capsule becomes incapable of floating so that the orientation of the capsule remains as shown in Figure 1 even when it has sunk.

However continued intrusion of beer eventually causes the weight of the beer above the platform to shift the centre of gravity of the overall capsule above the centre of area causing the capsule to become unstable and eventually rotate due to any external influence such as vibration into the position shown in Figure 2.

In this condition the only change which occurs is that the little buoyant ball 19 immediately rises to the other end of the tube 15 into the position shown in Figure 2 and impinges hard against the neck of the aperture 16. Since it is greater in diameter than the aperture 16 it will of course remain there and effectively seals the upper end of the tube.

The liquid which is now below the platform 20 due to the 180° rotation of the capsule, maintains the orientation of the capsule and since the tube 21 extends above the platform, there is no tendency for the liquid to shift through that tube into the upper compartment, even if the can is shaken. In practice the tube 21

6/22/2009, EAST Version: 2.3.0.3

may be extended considerably more into the compartment than is shown in Figures 1 and 2 so as to further reduce any likelihood of liquid being spilt into the upper compartment. In this way the upper compartment can be maintained totally dry and devoid of beer and when the can is broached, and the headspace pressure relieved, the gas under pressure in the upper region of the capsule immediately passes through the tube 22 and out through the orifice 23 as a fine jet into the beer in known manner causing frothing and a good head to be produced.

Although the capsule may spin around due to the issuing jet of gas, there is no tendency for the capsule to rise since its buoyancy remains substantially unaltered and it is retained in the lower reaches of the can by the mass of liquid contained therein in combination with the weight 17.

Figures 3 and 4 illustrate an alternative arrangement in which there is no requirement for a floating ball valve. In many respects the device is similar to that as shown in Figures 1 and 2 and for simplicity the same reference numerals are used throughout to denote similar items.

The operation of the device is identical to that as shown in Figures 1 and 2 but valves are shown associated with the aperture 16 and if desired the tube 21.

Detailed of the valves is contained in Figures 3A and 3B.

The valve associated with the tube 15 and the aperture 16 is shown in Figure 3A.

Here the lower end of the tube 15 is shown plugged with elastomeric plug 24 which is secured in the tube 15 and held in place for example by an inturned edge 25 and/or by an adhesive.

The elastomeric material is formed with an upper reduced diameter frusto-conical section 26 and a tapering bore 27 is formed

through the material from a large permanently open end 28 to the upper end of the frusto-conical section where the resilience of the material is such as to generally close the bore at 29.

The lower end 28 may be rendered permanently open by for example inserting a rigid sleeve into the material so as to hold the material open in the region of 28. The natural resilience of the elastomeric material above the sleeve 29 causes the walls of the frusto-conical section to collapse inwardly and close off the bore as described so that at the end 29 there is no aperture under normal circumstances.

A positive pressure below the plug 24 will force open the sleeve of elastomeric material 26 thereby enabling fluid to pass through the now open end 29.

The reverse situation (a positive pressure within the pipe 15) will have no such effect on the frusto-conical tubular section 26 and the positive pressure will tend to be maintained within the pipe 15 and will not leak to the outside through the bore 27.

It will therefore be seen that with the capsule floating as shown in Figure 3, positive pressure exerted by the static liquid head will cause liquid to permeate through the bore 27 in the plug 24 and fill up the tube 15 and upper region of the capsule above the platform 20 as previously described with reference to Figure 1.

As before provided the choice of the mass of the weight 17 and volume of the compartment above the platform 20 have been selected accordingly, the capsule can be made to sink and rotate as shown in Figure 4 with continued ingress of liquid.

Once the can is broached, the pressure differential across the valve at the end 16 of the tube 15 will be reversed causing the elastomeric walls 26 of the frusto-conical section to collapse and close off the entrance thereby trapping liquid in the tube 15 and preventing the liquid from being forced out through the

upper end of the tube as might otherwise be the case. The excess gas pressure within the capsule is thus fully available for forming a jet through the small orifice 23 in the manner hereinbefore described.

A second one way valve is shown in Figure 3B for fitting to the lower end of the tube 21 as shown in Figure 3. This is also formed from elastomeric material and is adapted to be secured to the lower end of the tube 21 as by an adhesive. A bore 30 is formed through the interior of the elastomeric material denoted by reference numeral 31 and by virtue of the natural resilience of the material and the frusto-conical form, the wall of the frusto-conical section of the foot in the region 32 collapses inwardly to close off the end 33 so that there is little tendency for fluid to pass into the tube 21 via the foot 31. However a positive pressure differential in the opposite sense will force open the elastomeric material in the region 32 thereby enabling fluid flow through the foot.

As will be seen in Figure 3, gas pressure building up within the headspace above the liquid above the platform 20 as the capsule begins to fill with liquid, will eventually open the elastomeric sleeve 32 and relieve the pressure in to the lower region of the capsule.

However when the capsule is inverted, and the headspace 13 is relieved to atmospheric pressure, the positive pressure within the capsule 40 will effectively close the elastomeric wall 32 and close off the end 33 thereby further reducing the tendency of any gas to transfer into the lower region of the capsule below the platform 20 and thereby pressurise the liquid therein.

It will be seen that either the valve of Figure 3A or that of Figure 3B is sufficient to substantially prevent depressurisation of the capsule other than through the outlet 23 when the can is broached but the presence of both valves will virtually eliminate any tendency for such depressurisation other than through the

6/22/2009, EAST Version: 2.3.0.3

aperture 23.

In the diagrammatic plan view of Figure 5 containers exiting a filler carousel 40 along line 42 pass directly into a second carousel 44 where capsules are inserted into the containers. These leave carousel 44 on path 46 to a seamer (not shown) where the can is dosed with liquid nitrogen and the lid is affixed and sealed in place.

Figure 6 illustrates how a capsule filling carousel such as 44 can be fed with spherical capsules.

A purge chamber 48 is supplied with assembled spherical capsules. When filled, the purge chamber is sealed and evacuated using a vacuum pump 50. After evacuation, the chamber is filled with nitrogen from a suitable supply along line 52 so that the capsules are now in a nitrogen environment and the interiors will be filled with nitrogen.

The contents of the purge chamber 48 can be transferred to a holding tank 54 when required so that a fresh purging process can be carried out on a fresh batch of capsules.

The holding tank 54 is supplied with nitrogen at a pressure slightly in excess of atmospheric and periodically capsules in the holding tank are transferred to the filler dispenser 56 by lowering a bell valve 58. A similar device (bell valve) is used for transferring capsules between the purge chamber and the holding tank.

Capsules in the filler dispenser 56 are maintained in a nitrogen atmosphere thereby preserving atmospheric integrity and from the filler dispenser 56 are allowed to roll into radially positioned escapement shoots 60 and 62 to be deposited into cans such as 64 and 66. The latter are supported on a lifting table 68. During the filling cycle the system is configured to carry out further purging of the container headspace as by evacuation, purging with nitrogen and liquid nitrogen dosing.

An alternative arrangement is shown in Figure 7 in which purged capsules from stock such as the filler dispenser 56 of Figure 6, are supplied via a feed line 70 to an auger feed generally designated 72. The auger rotates about the axis 74 and the pitch of the auger varies along the axial length of the feed so that capsules such as 76 are captured by the auger and separated and spaced apart with movement along the table 78 until they reach the drop-off point 80. The latter is situated above a conveyor 82 on which cans are located and the conveyor and line of cans moves in the direction of the arrow 84 and is synchronised with the movement of the auger feed 72 so that capsules arrive at the drop-off point in synchronism with the arrival of the next empty can below the drop-off point 80. Thus capsule 86 is shown just about to drop into can 88.

By synchronising the movement, the next capsule 90 will arrive at the drop-off point 80 when can 92 arrives below the point 80. In this way capsules are separated and fed individually to the cans.

Each of the cans has previously been filled with beverage and the level of the beverage in the cans is denoted by reference numeral 94. As shown with reference to can 96, the capsule 98 floats in the beverage with the majority of the capsule below the level of the surface such as is shown in Figures 1 and 3.

The conveyor 82 moves the line of cans towards the seamer where just prior to the lid being applied to the can, the can is dosed with liquid nitrogen in known manner and thereafter sealed so that the process of gaseous priming of the capsule 98 can be performed as previously described.

Figure 8 illustrates a fully integrated on-line insertion plant. Here the cans are supplied along a conveyor path 100 to a filling carousel 102. Filled cans are supplied to the capsule loading auger 104 fed from the feed hopper 106. A bell valve 108 releases capsules into the hopper 106 from a purge chamber 110

itself fed from a hopper 112.

Capsules supplied to the auger 104 are transferred individually into the cans in the manner previously described in relation to Figure 7 and the cans are immediately transferred to the seamer (not shown).

A perspective overview of the complete system showing where the capsule insertion stage would be located is shown in Figure 8a.

Also shown in Figure 8 is the vacuum pump 114 for evacuating the purge chamber 110 via pipe 116. Not shown is the nitrogen input to the purge chamber and feed hopper.

Also now shown is shrouding around the auger 104 so that the auger filling stage can itself be operated in a nitrogen envelope to further maintain the integrity of the purged capsules so that there is little chance of any oxygen entering the capsule and thereby entering the cans.

The headspace is purged in the normal way which may involve evacuation, nitrogen blanketing, nitrogen dosing and the like prior to seaming.

6/22/2009, EAST Version: 2.3.0.3

CLAIMS

1. A device for generating a head on a beverage in a sealed container, when the container is opened, comprising a substantially hollow capsule having a first aperture, a second aperture remote from the first aperture, ballast means within the device selected as regards mass and position therein such that the capsule will float in a liquid with the first aperture above the liquid surface and the other immersed, and wherein liquid can enter an uppermost compartment in the capsule through the immersed aperture, the mass of liquid entering the capsule combining with the ballast to cause the capsule to rotate at least to the extent that the respective conditions of the two apertures are reversed, and a movable valve closure element within the capsule which can be closed so that when the latter is rotated the further ingress of liquid into the lowermost compartment is inhibited and a volume of gas is trapped in the remaining part of the capsule.

2. A device according to claim 1, wherein the valve element is moved by rotation of the capsule.

3. A device according to claim 2, wherein the valve means is moved by relative movement between a flotation member and the capsule wall on rotation of the capsule.

4. A device according to claim 1 or claim 2 or claim 3, wherein the ballast means is fixed in position within the capsule.

5. A device according to any of claims 1 to 4, wherein the second aperture communicates with the interior of the capsule by means of an elongate open ended tube which extends across the capsule to the compartment therein, which is bounded by an

internal region of the inside surface of the capsule which is generally diametrically opposite the position of the said second aperture, the said first aperture is situated in said same region of the capsule wall, close to but not aligned with the open end of the first said elongate tube, and the said first aperture communicates with the remaining part of the capsule interior by means of a second elongate open ended tube.

6. A device according to claim 5, wherein the second tube extends from the said first aperture internally of the capsule generally parallel to the first mentioned tube, the length of the tube associated with the said first aperture being selected so that when the capsule is rotated and the said first aperture is on the underside of the capsule, the other (now upper) end of the second tube is situated in a region of the capsule which contains gas and is above the level of any liquid-containing compartment.

7. A device according to any of claims 1 to 6, wherein the size of the first aperture is in the range 150-300 microns diameter.

8. A device according to any of claims 1 to 7 wherein the said compartment is separated from the remaining part of the capsule interior by means of an impermeable membrane or platform and the first and second tubes extend through and are externally sealed thereto where they pass therethrough.

9. A device according to claim 8, wherein the platform/membrane is situated nearer to the open end of the first tube than the other end thereof so that the volume of the said compartment is less than the remaining volume of the interior of the capsule.

10. A device according to any of claims 1 to 9, wherein fluid communication is permitted between the compartment and the remaining part of the capsule so that as liquid enters the compartment gas is displaced via the said communication to the said remaining part of the capsule interior, from which gas can pass to a container headspace via the second tube and the first

aperture to maintain pressure balance as between the inside and outside of the capsule.

11. A device according to claim 10, wherein the said fluid communication is by means of a third tube which sealingly extends through the platform.

12. A device according to claim 11, wherein the third tube extends above the platform into the said compartment to a position just below the surface of said internal wall region of the capsule.

13. A device according to claim 12, wherein the third tube extends just below the platform into the remaining part of the capsule.

14. A device according to any of claims 1 to 13, wherein the ballast comprises an annular weight fitted around the first mentioned tube which extends from the said second aperture into the capsule and is positioned therealong and having a mass such that the capsule will settle with the small first aperture positioned just above the surface of the liquid.

15. A device according to claim 5 or any claim appendant thereto, when appendant to claim 3, wherein the valve element comprises a floating element contained within the first mentioned tube, serving to close the upper end of the tube in the initial condition of the capsule and close the lower end of said tube in the inverted condition of the capsule.

16. A device according to claim 15 when appendant to claim 9, wherein, in the initial condition of the capsule, liquid overflows into the said compartment through apertures in the first mentioned tube adjacent its upper end, to be retained in said compartment by said membrane/platform.

17. A device according to any of claims 1 to 16, when located

within the sealed and pressurised container which is partially filled with liquid, wherein the interior of the capsule is pressurised by the gas in the headspace above the liquid to the same elevated pressure as that of the headspace, and, after the capsule inverts, the trapped gas remains at the elevated pressure and is available to exit from the capsule when the container is opened and the pressure in the container drops.

18. A device according to claim 17, arranged so that the issuing gas has to pass through the liquid before it can escape to atmosphere, the issuing gas initiating an avalanche effect on the dissolved gases and creating a head of fine bubbles on the liquid.

19. A device according to claim 18, wherein the size of the aperture through which the gas is to issue into the liquid is selected so as to create such a line jet.

20. A device according to claim 19, wherein, by appropriate selection of position and/or direction of jet, the exiting gas from the capsule causes the latter to rotate within the container, thus expelling gas around the whole of the cross-sectional area of the liquid in the container.

21. A device according to any of claims 17 to 20, wherein a one way valve is located in one or both of the apertures in the capsule and the capsule is weighted to float in a particular orientation with the upper aperture allowing flow of gas from the container headspace into the device and the lower aperture permitting positive pressure inside the device to vent through the submerged hole.

22. A sealed container partially filled with a liquid having gas dissolved therein and a headspace above the liquid containing gas at a pressure greater than atmospheric, and located within the said container a head generating device containing gas under pressure ass claimed in any of claims 1 to 17, so that when the

end of the container adjacent the headspace is broached as by severing a weakened tab region and the headspace pressure is relieved to atmosphere the trapped gas under pressure within the capsule will be jetted into the liquid to assist in the generation of an upward avalanche of small bubbles to form a head on the surface of the liquid when the latter is poured into a glass or other drinking vessel.

23. A method of trapping a volume of gas under pressure within a capsule located within a sealed container having liquid therein containing dissolved gases and a headspace containing gas under greater than atmospheric pressure comprises the steps of causing liquid to enter the capsule and thereby alter the stability thereof and result in a rotation of the capsule so that an aperture through which liquid is entering the capsule rises above the surface of the liquid and a smaller aperture through which gas is to jet when the can is opened is caused to rotate below the level of the liquid within the container.

24. A method according to claim 23, wherein the volume of liquid entering the capsule is arranged to alter the buoyancy thereof to such an extent that the capsule sinks within the liquid either before, after or during inversion so that the device is situated at or near the bottom of the container at the time when the can is broached and the headspace pressure relieved.

25. A method according to claim 23 or claim 24 employing a spherical capsule.

26. A canning plant for producing sealed containers according to the method of any of claims 23 to 25, wherein capsules waiting to be inserted into cans are maintained in an inert atmosphere, typically nitrogen, under pressure greater than atmospheric, so that the capsules are oxygen free when inserted into the cans.

6/22/2009, EAST Version: 2.3.0.3

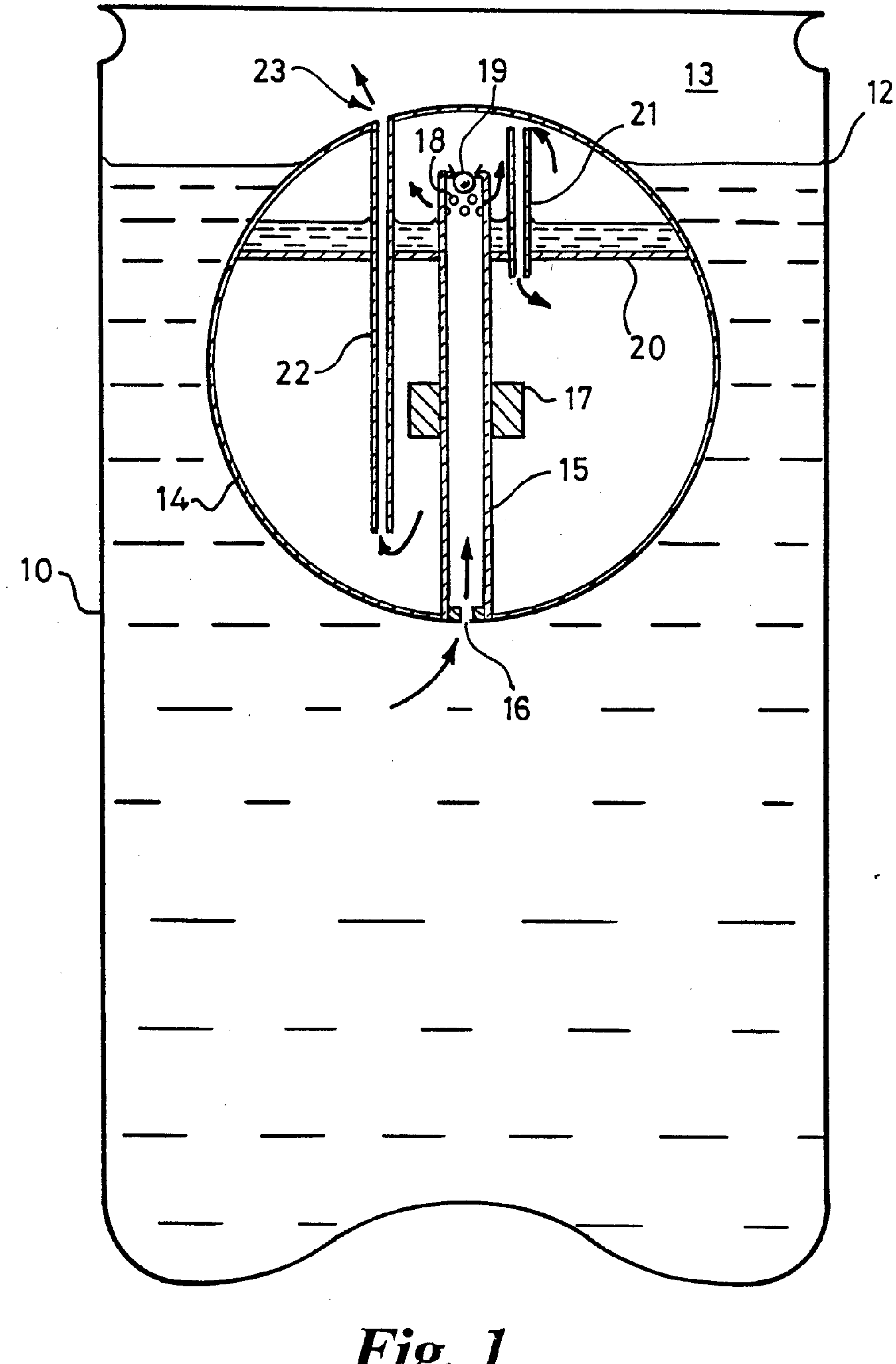


Fig. 1

6/22/2009, EAST Version: 2.3.0.3

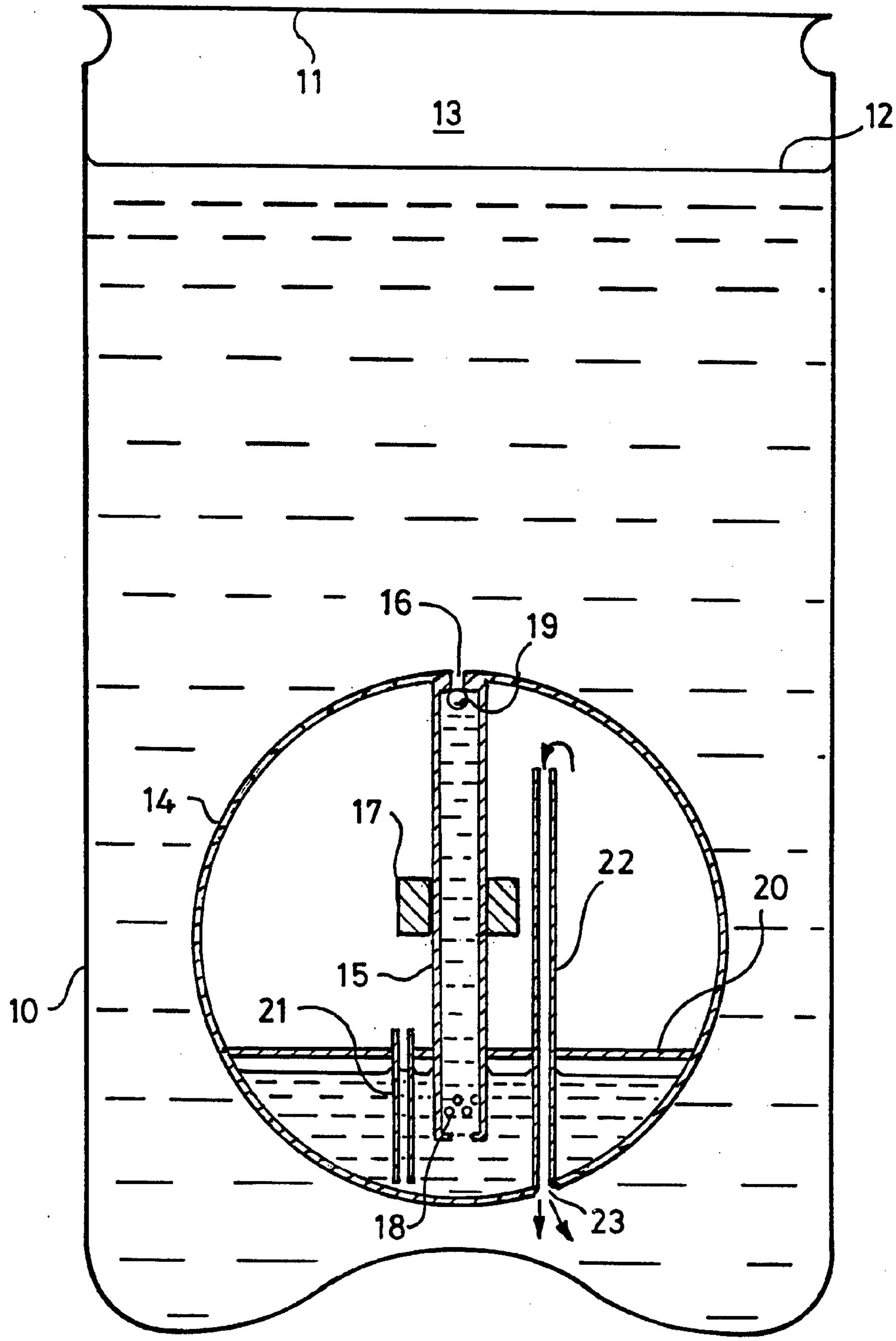


Fig. 2

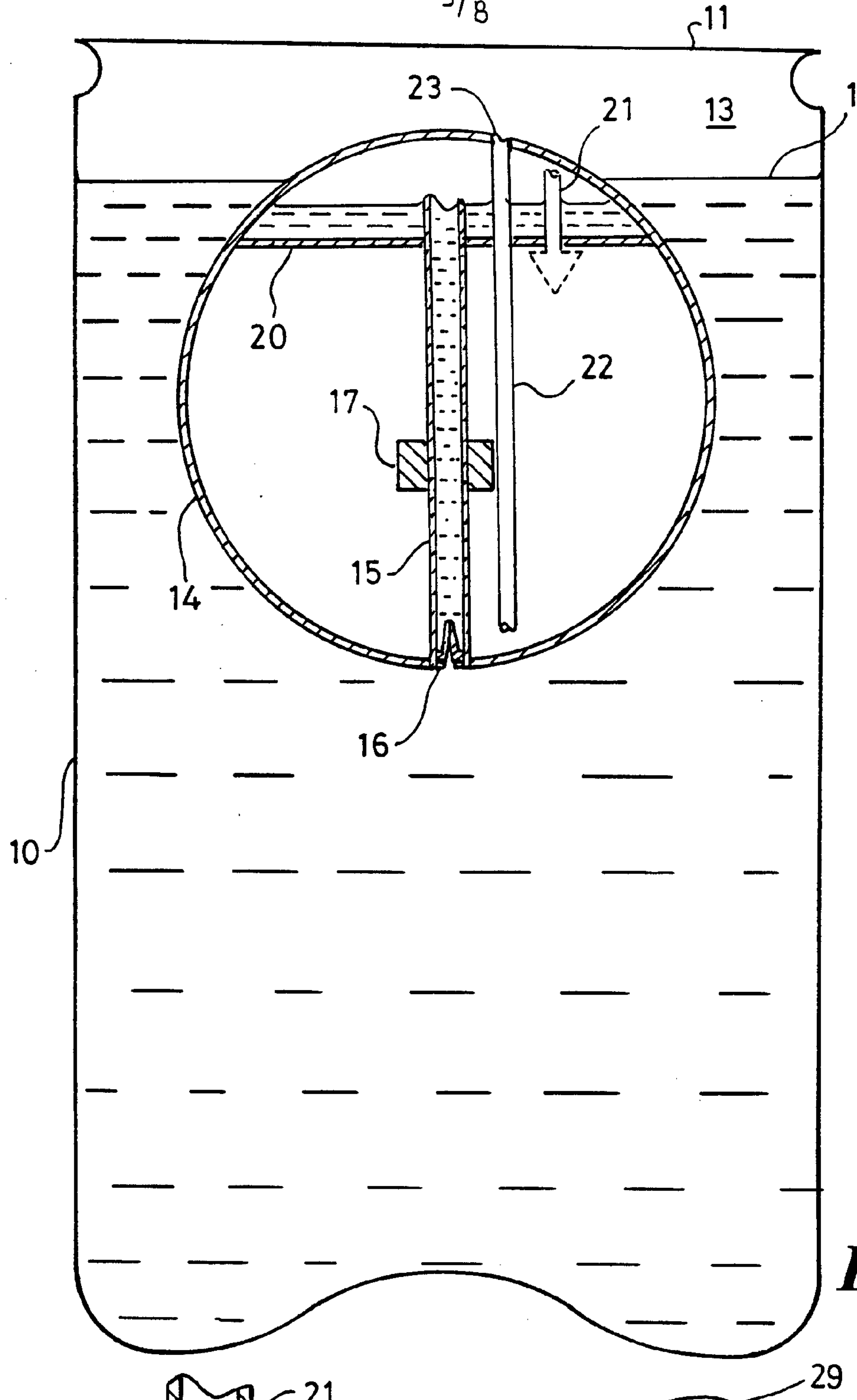


Fig. 3

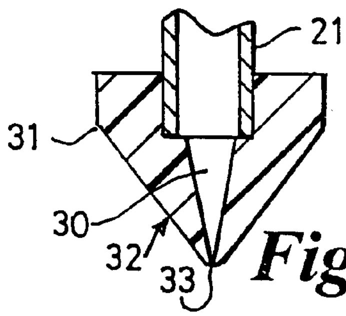


Fig. 3B

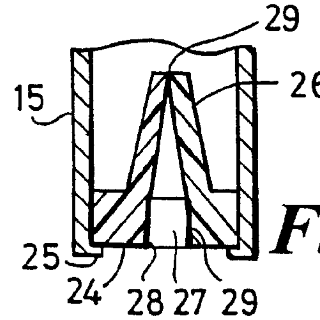


Fig. 3A

6/22/2009, EAST Version: 2.3.0.3

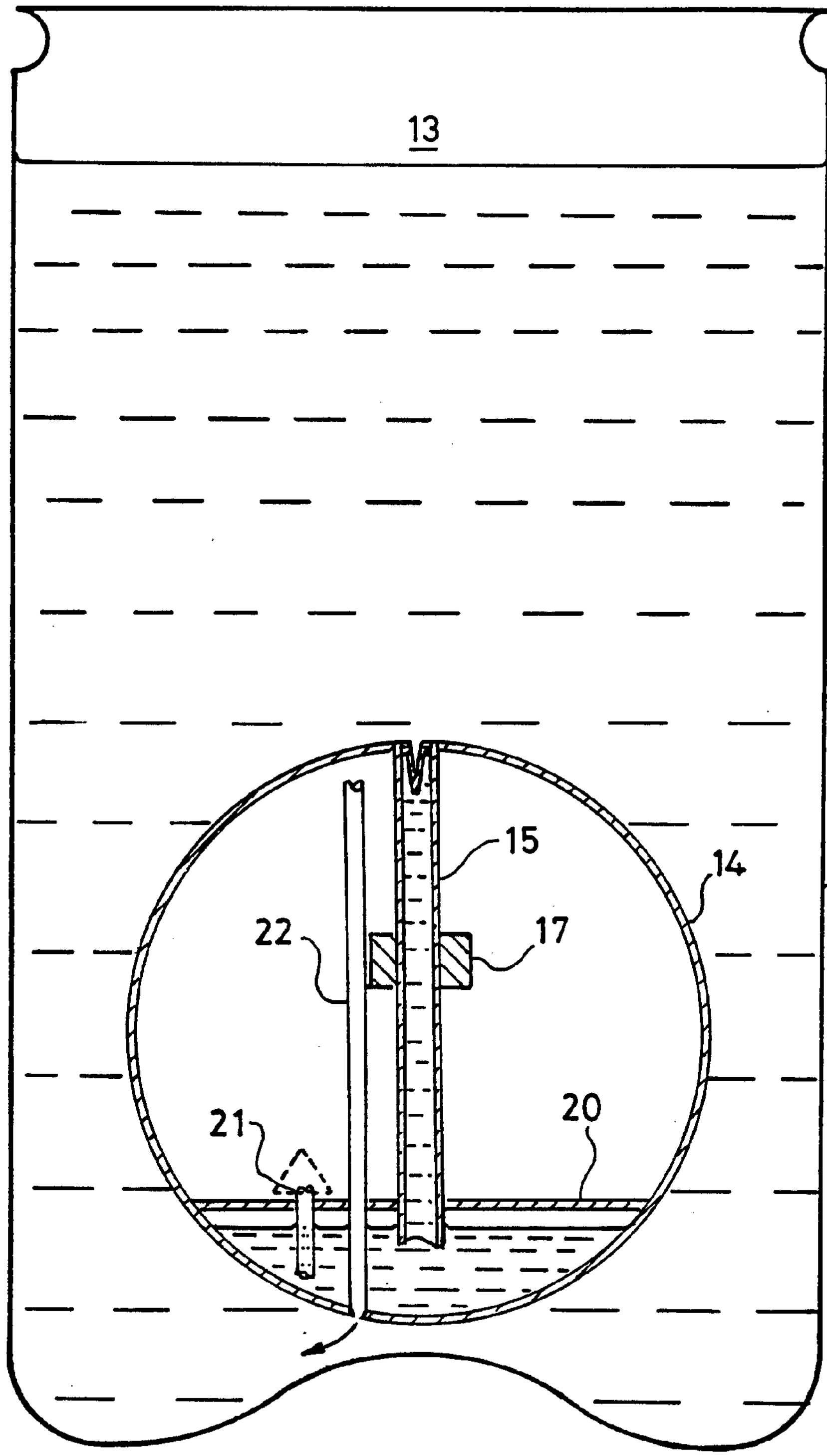


Fig. 4

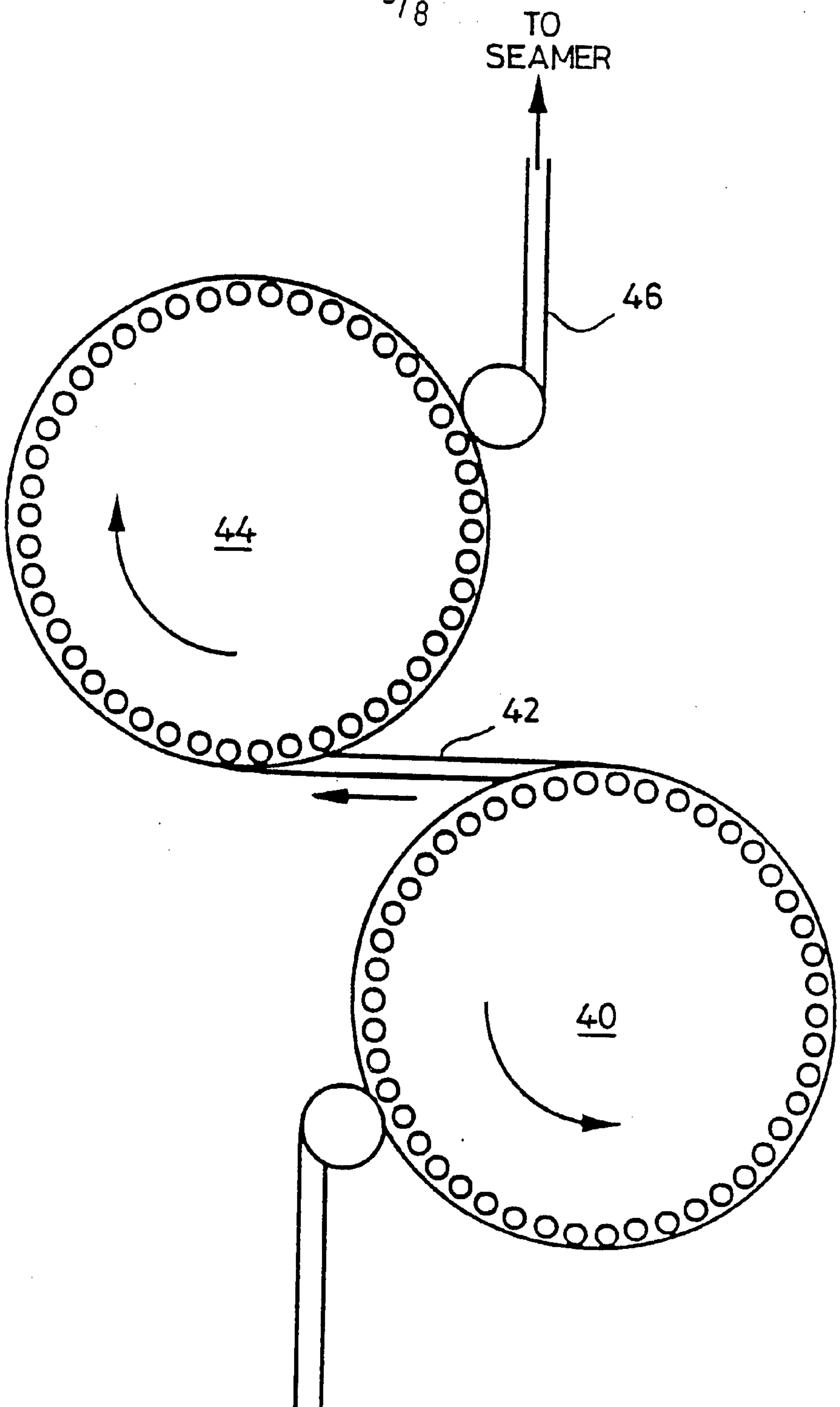


Fig. 5

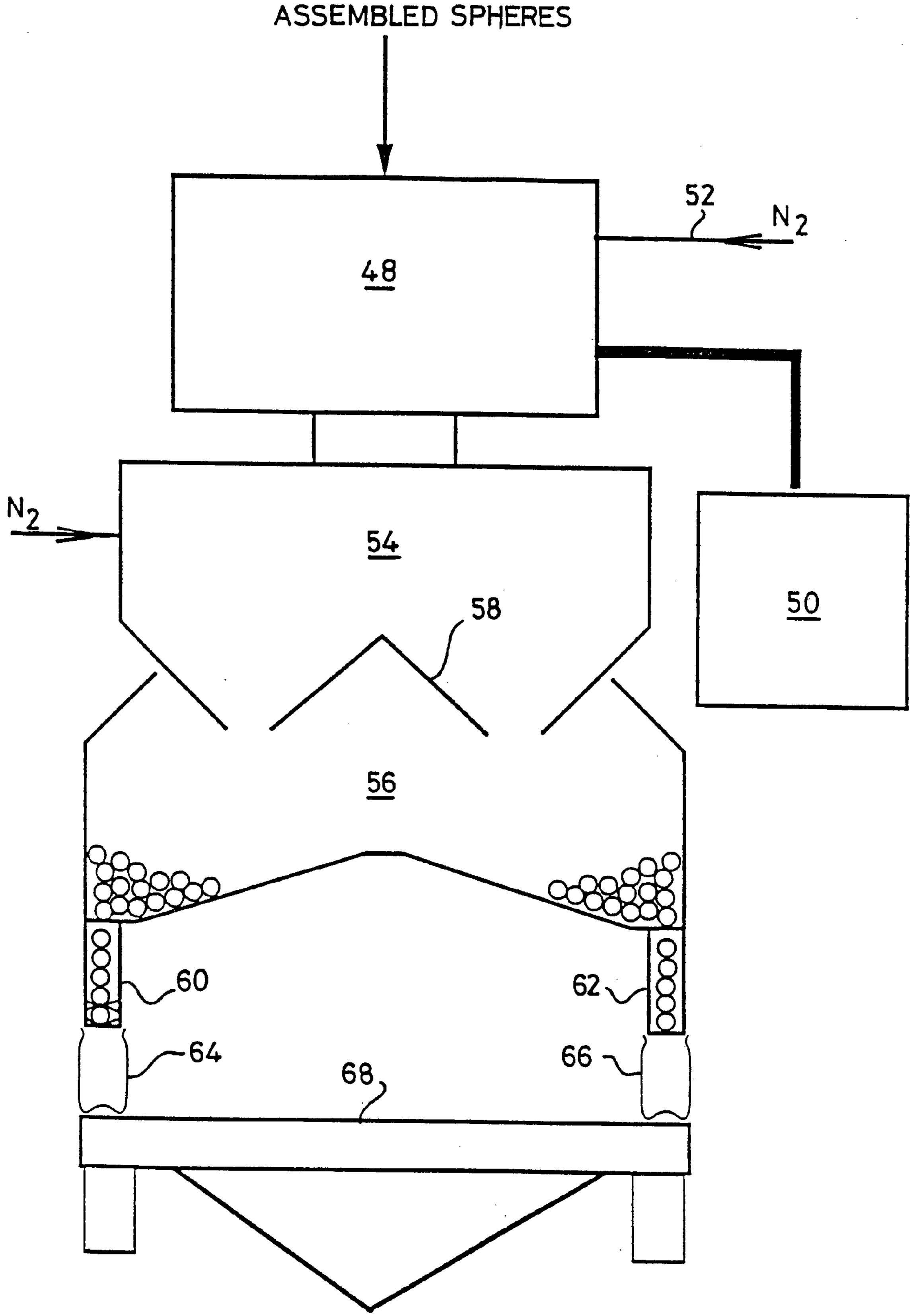


Fig. 6

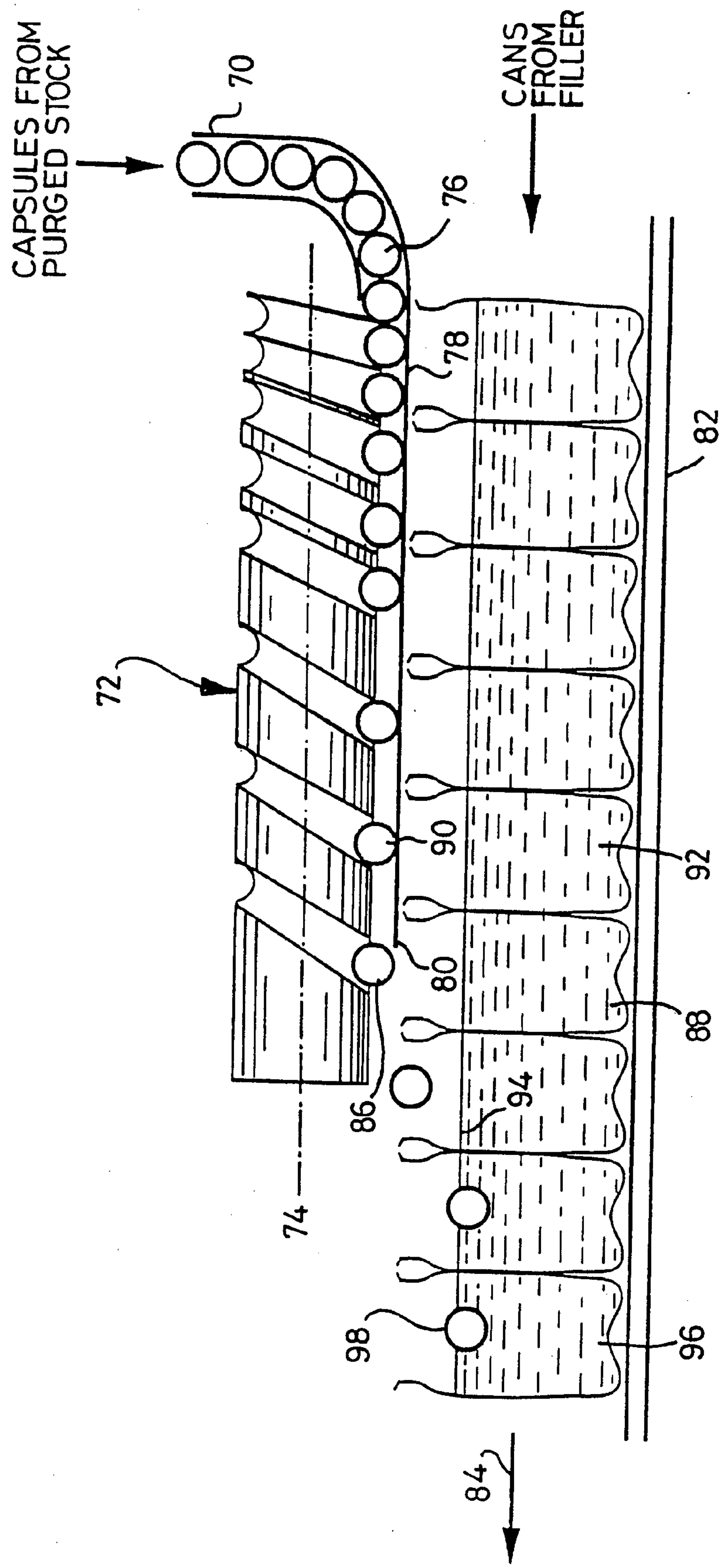

CAPSULES FROM
PURGED STOCK
CANS
FROM
FILLER
70
76
78
72
74
82
90
92
80
88
86
94
98
96
84

Fig. 7

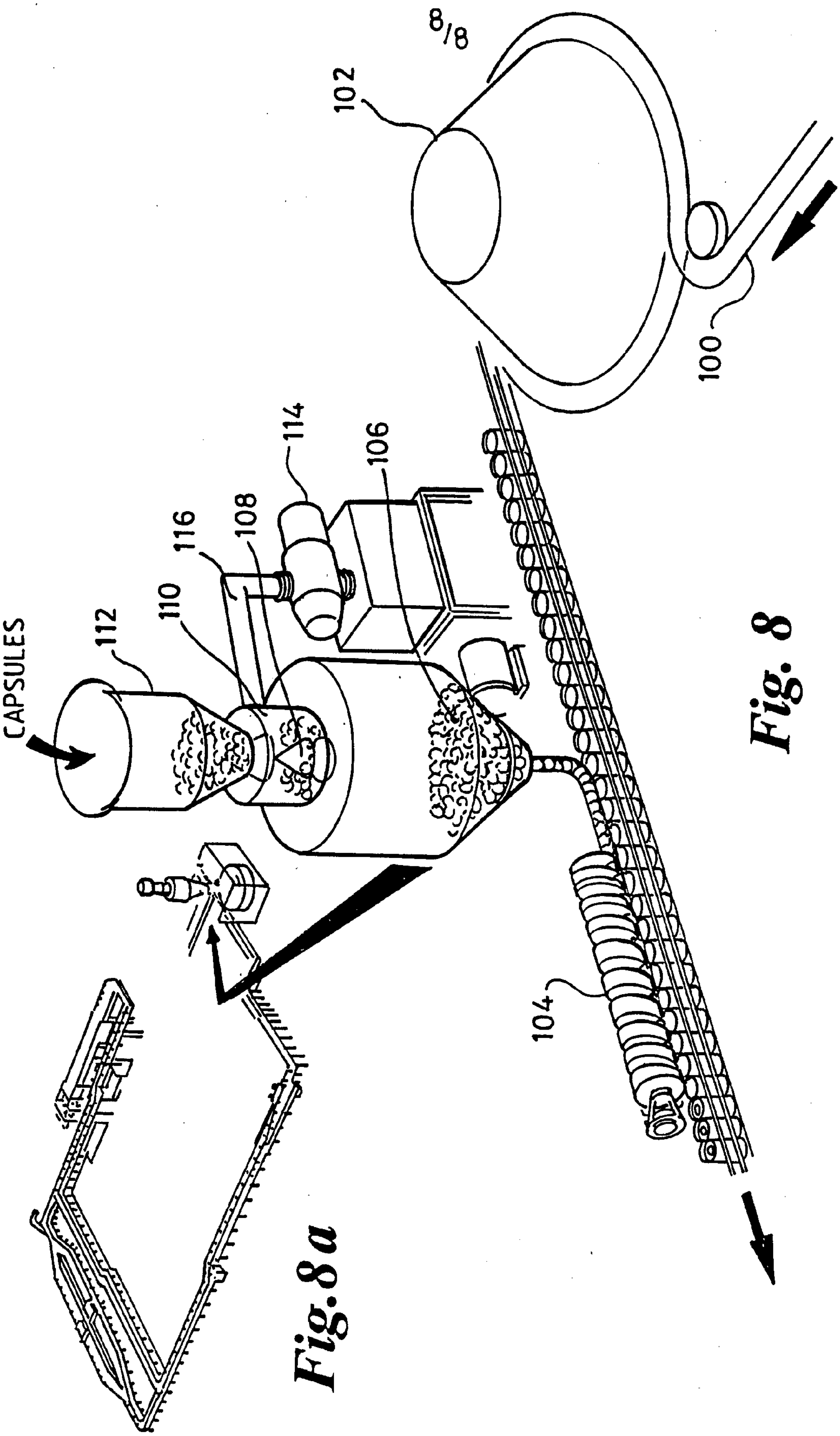


Fig. 8

Fig.8a